

Claims

- 1 1. Motor vehicle electric system comprising an internal combustion engine and, 2 mechanically connected thereto, an integrated starter-generator that charges a double 3 layer capacitor and a battery to a first voltage via a bi-directional AC/DC converter in 4 generator mode and is driven by the energy stored in the double layer capacitor or in 5 the battery in motor mode, wherein an intermediate circuit capacitor is arranged 6 between the positive and negative direct voltage terminals of the bi-directional AC/DC 7 converter, a first switch is provided via which the positive direct voltage terminal of 8 the bi-directional AC/DC converter can be connected to the plus pole of the battery, 9 the minus pole of which is grounded, and a second switch is provided via which the 10 positive direct voltage terminal of the bi-directional AC/DC converter can be 11 connected to the positive terminal of the double layer capacitor, the negative terminal 12 of which is grounded.

- 1 2. Motor vehicle electric system according to Claim 1, wherein the first and 2 second switches are interlinked in such a way that they cannot both be in the 3 conducting position at the same time.

- 1 3. Motor vehicle electric system according to Claim 1, wherein the intermediate 2 circuit capacitor can be charged from the AC/DC converter to a voltage value 3 corresponding to the voltage at the double layer capacitor or the battery before the first 4 or second switch is switched to the conducting position.

- 1 4. Motor vehicle electric system according to Claim 1, wherein the flow of 2 current into the AC/DC converter or out of the AC/DC converter can be reduced to a 3 minimal value before the first or second switch is switched to the non-conducting 4 position.

1 5. Motor vehicle electric system according to Claim 1, wherein a regulator circuit
2 is provided by means of which the double layer capacitor can be recharged from the
3 battery.

1 6. Motor vehicle electric system according to Claim 1, wherein the double layer
2 capacitor is charged to an elevated voltage higher than the voltage of the battery.

1 7. Motor vehicle electric system according to Claim 1, comprising an additional
2 battery to supply additional loads with a second voltage, which additional battery is
3 charged via a bi-directional DC/DC converter by the battery, wherein a third switch is
4 provided via which the plus pole of the first battery can be connected to a positive
5 terminal of the bi-directional DC/DC converter, and a fourth switch is provided via
6 which the positive terminal of the double layer capacitor can be connected with the
7 same positive terminal of the bi-directional DC/DC converter.

1 8. Motor vehicle electric system according to Claim 7, wherein the third and
2 fourth switches are interlinked in such a way that they cannot both be in the
3 conducting position at the same time.

1 9. Motor vehicle electric system according to Claim 1, comprising a
2 control/regulation circuit for controlling /regulating operations from the group of
3 - charging the intermediate circuit capacitor via the AC/DC converter to a voltage
4 value corresponding to the voltage at the double layer capacitor or the 36 V
5 battery,
6 - determining the working direction of the converters (step-up or step-down), and
7 - controlling the positions of switches S1 to S4.

- 1 10. Motor vehicle electric system according to Claim 1, wherein
- 2 - when the integrated starter-generator is in generator mode:
 - 3 - the intermediate circuit capacitor is charged to a predefinable voltage when the
 - 4 switches are non-conducting,
 - 5 - the battery is charged when the first switch is conducting and
 - 6 - the double layer capacitor is charged when the second switch is conducting and
 - 7 - when the integrated starter-generator is in motor mode:
 - 8 - the starter-generator is driven with energy from the battery when the first
 - 9 switch is conducting and
 - 10 - the starter-generator is driven with energy from the double layer capacitor
 - 11 when the second switch is conducting.
- 1 11. Motor vehicle electric system according to claim 7, wherein
- 2 - the battery charges or is charged by the additional battery when the third switch
- 3 is conducting and
- 4 - the double layer capacitor charges or is charged by the additional battery when
- 5 the fourth switch is conducting.
- 1 12. Motor vehicle electric system according to claim 8, wherein
- 2 - the battery charges or is charged by the additional battery when the third switch
- 3 is conducting and
- 4 - the double layer capacitor charges or is charged by the additional battery when
- 5 the fourth switch is conducting.

- 1 13. Method of operating a motor vehicle electric system comprising an integrated
- 2 starter-generator comprising the steps of:
 - 3 - charging a double layer capacitor and a battery to a first voltage via a bi-directional
 - 4 AC/DC converter in a generator mode,
 - 5 - driving the starter-generator by the energy stored in the double layer capacitor or in
 - 6 the battery in a motor mode,
 - 7 - arranging an intermediate circuit capacitor between the positive and negative direct
 - 8 voltage terminals of the bi-directional AC/DC converter,
 - 9 - providing a first switch via which the positive direct voltage terminal of the bi-
 - 10 directional AC/DC converter can be connected to the plus pole of the battery, the
 - 11 minus pole of which is grounded, and
 - 12 - providing a second switch via which the positive direct voltage terminal of the bi-
 - 13 directional AC/DC converter can be connected to the positive terminal of the double
 - 14 layer capacitor, the negative terminal of which is grounded.
- 1 14. Method according to Claim 13, further comprising the step of interlinking the
- 2 first and second switches in such a way that they cannot both be in the conducting
- 3 position at the same time.
- 1 15. Method according to Claim 13, further comprising the step of charging the
- 2 intermediate circuit capacitor from the AC/DC converter to a voltage value
- 3 corresponding to the voltage at the double layer capacitor or the battery before the first
- 4 or second switch is switched to the conducting position.
- 1 16. Method according to Claim 13, further comprising the step of reducing the
- 2 flow of current into the AC/DC converter or out of the AC/DC converter to a minimal
- 3 value before the first or second switch is switched to the non-conducting position.
- 1 17. Method according to Claim 13, further comprising the step of recharging the
- 2 double layer capacitor from the battery by a regulator circuit.

1 18. Method according to Claim 13, further comprising the step of charging the
2 double layer capacitor to an elevated voltage higher than the voltage of the battery.

1 19. Method according to Claim 13, further comprising the steps of:
2 - charging an additional battery via a bi-directional DC/DC converter by the battery,
3 - providing a third switch via which the plus pole of the first battery can be connected
4 to a positive terminal of the bi-directional DC/DC converter, and
5 - providing a fourth switch via which the positive terminal of the double layer
6 capacitor can be connected with the same positive terminal of the bi-directional
7 DC/DC converter.

1 20. Method according to Claim 19, further comprising the step of interlinking the
2 third and fourth switches in such a way that they cannot both be in the conducting
3 position at the same time.

1 21. Method according to Claim 13, further comprising the step of controlling
2 /regulating operations from the group of:
3 - charging the intermediate circuit capacitor via the AC/DC converter to a voltage
4 value corresponding to the voltage at the double layer capacitor or the 36 V
5 battery,
6 - determining the working direction of the converters (step-up or step-down), and
7 - controlling the positions of switches S1 to S4.

- 1 22. Method according to Claim 13, further comprising the steps of
- 2 - when the integrated starter-generator is in generator mode:
 - 3 - charging the intermediate circuit capacitor to a predefinable voltage when the
 - 4 switches are non-conducting,
 - 5 - charging the battery when the first switch is conducting and
 - 6 - charging the double layer capacitor when the second switch is conducting and
 - 7 - when the integrated starter-generator is in motor mode:
 - 8 - driving the starter-generator with energy from the battery when the first switch
 - 9 is conducting and
 - 10 - driving the starter-generator with energy from the double layer capacitor when
 - 11 the second switch is conducting.
- 1 23. Method according to Claim 19, further comprising the step of
- 2 - the battery charges or is charged by the additional battery when the third switch
- 3 is conducting and
- 4 - the double layer capacitor charges or is charged by the additional battery when
- 5 the fourth switch is conducting.
- 1 24. Method according to Claim 20, further comprising the step of
- 2 - the battery charges or is charged by the additional battery when the third switch
- 3 is conducting and
- 4 - the double layer capacitor charges or is charged by the additional battery when
- 5 the fourth switch is conducting.